



New records and an updated checklist of amphibians from Lai Chau Province, Vietnam

Anh Mai Luong¹, Cuong The Pham¹, Quyen Hanh Do², Chung Van Hoang^{3,4,5}, Tien Quang Phan¹,
Truong Quang Nguyen^{1,6}, Thomas Ziegler^{7,8}, Minh Duc Le^{2,9,10,*}

- 1** Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, Hanoi, Vietnam • AML: luongmaianhsinhk62b@gmail.com <https://orcid.org/0000-0002-9524-8214> • CTP: cuongiebr@gmail.com <https://orcid.org/0000-0001-5158-4526> • TQP: quangtien120892@gmail.com • TQN: nqt2@yahoo.com <https://orcid.org/0000-0002-6601-0880>
- 2** Faculty of Environmental Sciences, University of Science, Vietnam National University, Hanoi, Vietnam • QHD: quyendo.k59@gmail.com <https://orcid.org/0000-0002-9437-4673> • MDL: le.duc.minh@hus.edu.vn <https://orcid.org/0000-0002-2953-2815>
- 3** CAS Key Laboratory of Mountain Ecological Restoration and Bioresource Utilization and Ecological Restoration and Biodiversity Conservation Key Laboratory of Sichuan Province, Chengdu Institute of Biology, Chinese Academy of Sciences, Chengdu, China
- 4** University of Chinese Academy of Sciences, Beijing, China
- 5** Forest Resources and Environment Center, Hanoi, Vietnam • chungiebr@gmail.com <https://orcid.org/0000-0002-0709-974X>
- 6** Graduate University of Science and Technology, Vietnam Academy of Science and Technology, Hanoi, Vietnam
- 7** Cologne Zoo, Cologne, Germany • ziegler@koelnerzoo.de <https://orcid.org/0000-0002-4797-609X>
- 8** Institute of Zoology, University of Cologne, Cologne, Germany
- 9** Central Institute for Natural Resources and Environmental Studies, Vietnam National University, Hanoi, Vietnam
- 10** Department of Herpetology, American Museum of Natural History, New York, NY, USA
- * Corresponding author

Abstract

We provide a checklist of 45 species of amphibians from Lai Chau Province, northwestern Vietnam. Thirteen of species are recorded for the first time from Lai Chau Province; these include four species of Dicroglossidae, four species of Megophryidae, three species of Ranidae, and two species of Rhacophoridae. We also provide descriptions of the newly recorded species. The amphibian fauna of Lai Chau Province is of high conservation concern, with three species endemic to Vietnam, 10 species listed in the IUCN Red List, and two species listed in the Red Data Book of Vietnam.

Keywords

Faunal/herpetological survey, morphology, taxonomy

Academic editor: Perry L. Wood, Jr. | Received 21 October 2020 | Accepted 19 January 2021 | Published 9 March 2021

Citation: Luong AM, Pham CT, Do QH, Hoang CV, Phan TQ, Nguyen TQ, Ziegler T, Le MD (2021) New records and an updated checklist of amphibians from Lai Chau Province, Vietnam. Check List 17 (2): 445–458. <https://doi.org/10.15560/17.2.445>

Introduction

Lai Chau Province is located in northwestern Vietnam and encompasses an area of 283,667 ha of secondary and primary evergreen forest (The People’s Committee of

Lai Chau Province 2019). In terms of amphibian diversity, Lai Chau Province is one of the most poorly studied provinces in northern Vietnam. In their herpetofaunal

book of Vietnam, Nguyen et al. (2009) recorded 24 species of amphibians from Lai Chau Province. In recent years, more surveys have been undertaken in the area and numerous new findings have been recorded from this province. For example, two new species were recently discovered, namely *Megophrys hoanglienensis* Tapley, Cutajar, Mahony, Nguyen, Dau, Luong, Le, Nguyen, Nguyen, Portway, Luong & Rowley, 2018 and *Tylototriton sparreboomi* Bernardes, Le, Nguyen, Pham, Pham, Nguyen & Ziegler, 2020 (Tapley et al. 2018; Bernardes et al. 2020). In addition, eight new provincial records of amphibians were reported from Lai Chau, viz. *Leptobranchella minima* (Taylor, 1962), *Nidirana chapaensis* (Bourret, 1937), *Sylvirana cubitalis* (Smith, 1917), *S. menglaensis* (Fei, Ye & Xie, 2008), *Kurixalus bisacculus* (Taylor, 1962), *Polypedates megacephalus* Hallowell, 1861, *Rhacophorus kio* Ohler & Delorme, 2006, and *Theloderma bicolor* (Bourret, 1937) (Pham et al. 2018, 2019; Sung et al. 2019).

As a result of our recent field survey in Lai Chau Province in May 2020, we provide an updated checklist of 45 species of amphibians, including 13 new records from the province.

Methods

Sampling. The field survey was conducted by Cuong The Pham, Chung Van Hoang, Anh Van Pham, Tien Quang Phan, and Nenh Ba Sung on 11–23 May 2020 in Sin Ho and Tam Duong districts, Lai Chau Province (Fig. 1). The main habitat type was secondary forest of medium-sized and small hardwoods mixed with shrubs and bamboo at elevations between 1100 and 2500 m above sea level (a.s.l.) (Fig. 2). The coordinates (WGS 84) were recorded using a GPS Garmin 60CX receiver.

Specimens were collected between 19:00 h and 24:00 h. After photographing in life, specimens were euthanized in a closed vessel with a piece of cotton wool containing ethyl acetate (Simmons 2002), fixed in 80% ethanol for 5 h, and then later transferred to 70% ethanol for permanent storage. Tissue samples were preserved separately in 70% ethanol prior to fixation. Specimens referred to in this paper are deposited in the collections of the Institute of Ecology and Biological Resources (IEBR), Hanoi, Vietnam.

Morphological examination. Measurements were taken on preserved specimens with digital calipers to the nearest 0.1 mm. The following abbreviations were used: SVL = snout–vent length, HL = head length (from the back of mandible to tip of snout), HW = maximum head width (across angles of jaws), RL = rostral length (from anterior corner of orbit to tip of snout), NS = distance from nostril to the tip of snout, EN = distance from anterior corner of orbit to the nostril, IND = internarial distance, IOD = interorbital distance, ED = eye diameter, UEW = maximum width of upper eyelid, DAE = distance between anterior corners of orbits, MN = posterior

margin of mandible to nostril, MFE = posterior margin of mandible to anterior corner of orbit, MBE = posterior margin of mandible to posterior corner of orbit, DPE = distance between posterior corners of orbits, TYD = tympanum diameter, TYE = distance from anterior margin of tympanum to posterior corner of orbit, FLL = forearm length (from elbow to base of outer palmar tubercle), HAL = hand length (from base of outer palmar tubercle to tip of third finger), FL1–4 = Finger length I–IV, OPT = outer palmar tubercle length, IPT = inner palmar tubercle length, NPL = nuptial pad length, FeL = femur length (from vent to knee), TbL = tibia length (from knee to tarsus), TbW = maximum tibia width, FoL = foot length (from tarsus to the tip of fourth toe), TL1–5 = toe length I–V, IMT = inner metatarsal tubercle length. For the webbing formula, we followed Glaw and Vences (2007). Sex was determined by examination of the presence of nuptial pads and gonadal inspection.

Specimen identification. For taxonomic identification, we referred to Boulenger (1903), Bourret (1942), Liu (1950), Liu et al. (1960), Liu and Hu (1960), Taylor (1962), Ho et al. (1999), Fei et al. (1983, 2010), Ohler et al. (2000), Bain et al. (2003), Hu et al. (2005), Ye et al. (2007), Hecht et al. (2013), Ziegler et al. (2014), McLeod et al. (2015), Nguyen et al. (2016), Tapley et al. (2017), Luong et al. (2018, 2019), and Pham et al. (2012). Species names follow Nguyen et al. (2009) and Frost (2020).

Results

Family Megophryidae Bonaparte, 1850

Leptobrachium ailaonicum (Yang, Chen & Ma, 1983)

Ailao Spiny Toad

Figure 3A

Material examined. VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.566584°N, 103.759786°E; alt. 2394 m; 18.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the ground near small stream, surrounding habitat covered by mixed secondary forest of medium-sized to large hardwoods and bamboo; 1 ♂, IEBR 4761 • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.410067°N, 103.611183°E; alt. 2367 m; 19.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the ground near small streams, surrounding habitat covered by mixed secondary forest of medium-sized to large hardwoods and bamboo; 4 ♂; IEBR 4762–4765.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Ho et al. (1999) and Fei et al. (2010). Size large (SVL 66.2–69.1 mm); head as wide as long (HW 26.8–29.7 mm, HL 26.6–28.4 mm); snout round, longer than eye diameter (RL 9.7–10.2 mm, ED 8.4–9.2 mm); nostril round, laterally positioned, closer to the tip of snout than to eye (NS 3.7–5.4 mm, EN 5.0–5.9 mm);

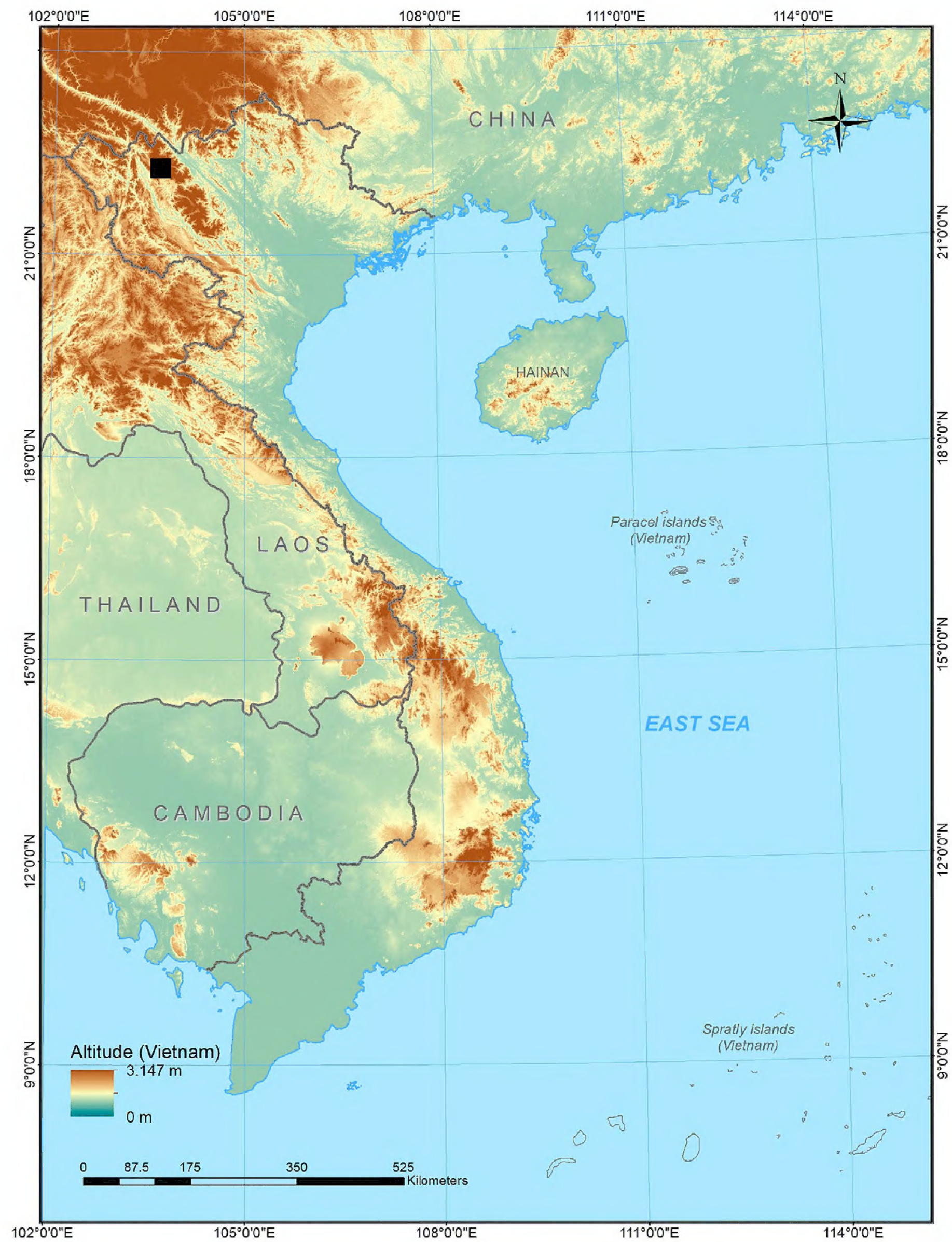


Figure 1. Map showing the sampling site in Lai Chau Province (black square), northwestern Vietnam.

canthus rostralis indistinct, eye large (ED 8.4–9.2 mm), tympanum indistinct; supratympanic fold distinct, vomerine teeth absent; tongue large, notched posteriorly; the males with 30–40 spines. Arm long (FLL 17.7–19.7 mm), relative lengths of fingers I<II<IV<III, tips of fingers swollen; fingers free of webbing, lateral fringes absent; subarticular tubercles distinct, formula 1, 2, 3, 2;

inner metatarsal tubercle, round, protuberant, larger than outer metatarsal tubercle, oval. Thigh short (FeL 29.8–35.1 mm); tibia approximately four times longer than wide (TbL 28.4–32.9 mm, TW 6.9–8.5 mm); tips of toes swollen; relative lengths of toes I<II<III<V<IV; webbing formula II–1III½–2III1–2½IV2½–1V; subarticular tubercles absent; inner metatarsal tubercle present, oval;



Figure 2. Habitats surveyed in Lai Chau Province, Vietnam. **A.** Evergreen forest. **B.** Microhabitat of a stream. Photographs by Hoang CV.

outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the eye when leg adpressed along body. Skin: dorsal surface of head, body, and upper limbs smooth with microscopic network of ridges; flanks, belly, chest, throat, ventral forelimbs and thighs with small pustules.

Coloration in life: dorsal surface of head, body and upper limbs brownish purple with dark brown mottling on back; ventral brown with white pattern; flanks with dark brown spotting and white pustules. Tips of digits, metacarpal and metatarsal tubercles white.

Distribution. In Vietnam, this species has been reported from Lao Cai, Son La and Yen Bai provinces (Nguyen et al. 2009, 2019; Frost 2020). Elsewhere, the species is known from Wenshan, Pingbian, and Yunnan provinces of China (Frost 2020).

***Megophrys gigantea* Liu, Hu, & Yang, 1960**

Giant Spadefoot Toad

Figure 3B

Material examined. VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.411667°N, 103.607750°E; alt. 2447 m; 18.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the banks of a small, rocky stream, surrounding habitat covered by mixed secondary forest of medium-sized to large hardwoods and bamboo; 3 ♂; IEBR 4766–4768 • Tam Duong District,

Ho Thau Commune, Ho Thau Village; 22.411667°N, 103.609767°E; alt. 2441 m; 19.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a small, rocky stream, surrounding habitat covered by mixed secondary forest of medium-sized to large hardwoods and bamboo; 1 ♂; IEBR 4769.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Liu et al. (1960), Fei et al. (2010), and Luong et al. (2019). Size large (SVL 82.8–89.9 mm); head as wide as long (HW 32.3–39.1 mm, HL 33.1–39.8 mm); snout pointed, longer than eye diameter (RL 10.1–11.5 mm, ED 9.5–10.9 mm); nostril oval, laterally positioned, at the midway between eye and tip of snout (NS 4.9–6.4 mm, EN 4.8–6.5 mm); canthus sharp, loreal region concave; eye large (ED 9.5–10.9 mm), tympanum indistinct; supratympanic fold distinct, vomerine teeth absent; tongue heart-shaped, slightly notched posteriorly. Arm long (FLL 15.3–19.8 mm), relative lengths of fingers I<II<IV<III, tips of fingers round; fingers free of webbing; subarticular tubercles indistinct; two round palmar tubercles, inner larger and more prominent. Thigh slender, long (FeL 40.0–44.9 mm); tibia approximately four times longer than wide (TbL 42.9–50.1 mm, TW 10.0–12.6 mm); relative lengths of toes I<II<V<III<IV; webbing formula II–1½III–2III2–3IV3–1½V; tips of toes slightly swollen; toes with dermal fringes; subarticular tubercles absent; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent; tibio-tarsal articulation reaching between eye and nostril when leg adpressed along body. Skin: dorsal surface smooth; supratympanic fold present, from posterior edge of eye to axilla; flanks smooth; ventral surface smooth; outer edge of the eyelid without a horn-like tubercle.

Coloration in life: dorsal surface yellowish brown, without black marking; loreal and supratympanic fold edged in black below; upper lip yellow; flanks yellowish brown; ventral surface brown with yellow pattern.

Distribution. In Vietnam, this species has been reported from Lao Cai and Son La provinces (Luong et al. 2019). Elsewhere, the species is known from Yunnan Province of China (Frost 2020).

***Megophrys jingdongensis* Fei & Ye, 1983**

Jingdong Horned Toad

Fig. 3C)

Material examined. VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.381867°N, 103.604400°E; alt. 1470 m; 15.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 2 ♂; IEBR 4770–4771.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those in the



Figure 3. Amphibians from Lai Chau Province, Vietnam. **A–D.** Megophryidae. **A.** *Leptobrachium ailaonicum* (IEBR 4761). **B.** *Megophrys gigantea* (IEBR 4766). **C.** *M. jingdongensis* (IEBR 4770). **D.** *M. rubrimera* (IEBR 4772). **E–H.** Dicroglossidae. **E.** *Limnonectes bannaensis* (IEBR 4778). **F.** *Nanorana aenea* (IEBR 4786). **G.** *N. yunnanensis* (IEBR 4792). **H.** *Quasipaa verrucospinosa* (IEBR 4797). Photographs by Hoang CV.

descriptions of Fei et al. (1983, 2009), Nguyen et al. (2016), and Luong et al. (2018). Medium-sized (SVL 50.8–54.4 mm); head narrower than long (HW 18.7–19.7 mm, HL 19.7–20.8 mm); snout pointed in dorsal view, longer than eye diameter (RL 6.5–7.0 mm, ED 6.4–6.6 mm); nostril oval, laterally positioned, at the midway between eye and tip of snout (NS 3.2–3.5 mm, EN 3.3–3.5 mm); canthus rostralis sharp, eye large (ED 6.4–6.6 mm), tympanum distinct (TYD 3.0–3.7 mm); supratympanic fold distinct, vomerine teeth present; tongue large, slightly notched posteriorly. Arm moderately slender (FLL 10.8–11.0 mm), relative lengths of fingers I<II<IV<III, tips of fingers round; fingers free of webbing; fingers without lateral fringes; subarticular tubercles absent; inner metatarsal tubercle present; outer metatarsal tubercle absent. Thigh slender (FeL 24.4–30.2 mm); tibia approximately six times longer than wide (TbL 30.2–33.5 mm, TW 4.9–5.8 mm); tips of toes round; relative lengths of toes I<II<V<III<IV; webbing formula II–1½ III–2½ III–2–3 IV–3–IV; subarticular tubercles absent; inner metatarsal tubercle present; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the snout when leg adpressed along body. Skin: dorsal surface of head and body smooth; flanks with small, scattered tubercles; small horn on upper eyelid; cloaca above and below with small tubercles; two dorsolateral parallel ridges on either side present; supratympanic fold present; ventral surface smooth.

Coloration in life: dorsal surface and lateral sides of head, body, forelimbs and hindlimbs grey; a dark brown triangular marking with a light central blotch between eyes; throat, chest and anterior part of belly primarily brown; belly cream with dark brown patterns; pectoral glands white.

Distribution. In Vietnam, this species has been reported from Lao Cai, Ha Giang, and Vinh Phuc provinces (Nguyen et al. 2009, 2016; Luong et al. 2018). Elsewhere, the species is known from Yunnan and Guangxi provinces, China (Frost 2020).

***Megophrys rubrimera* Tapley, Cutajar, Mahony, Chung, Dau, Nguyen, Luong & Rowley, 2017**

Red-thighed Horned Frog

Figure 3D

Material examined. VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.380933°N, 103.600500°E; alt. 1381 m; 15.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 1 ♂; IEBR 4772 • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.411667°N, 103.607750°E; alt. 2447 m; 18.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 2 ♂; IEBR 4773–4774 • Tam Duong District, Ho Thau Commune,

Ho Thau Village; 22.410067°N, 103.611183°E; alt. 2367 m; 19.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 2 ♂, 1 ♀; IEBR 4775–4777.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those in the description of Tapley et al. (2017). Size small (SVL 28.6–30.9 mm in males and SVL 29.3 mm in the female); head narrower than long (HW 9.6–11.3 mm, HL 10.2–11.5 mm in males; HW 12.8 mm, HL 13.4 mm in the female); snout round in dorsal view, as long as eye diameter in males (RL 3.5–3.9 mm, ED 3.0–3.9 mm); longer than eye diameter in the female (RL 4.8 mm, ED 4.1 mm); nostril oval, laterally positioned, closer to the tip of snout than to the eye (NS 1.3–1.9 mm, EN 1.6–2.2 mm in males; NS 2.2 mm, EN 2.5 in the female); canthus rostralis angular, eye large (ED 3.0–3.9 mm in males; ED 4.1 mm in the female), tympanum distinct (TYD 1.5–1.7 mm in males; TYD 2.0 mm in the female); supratympanic fold narrow, vomerine teeth present; tongue moderately large and not clearly notched posteriorly. Arm short and stocky (FLL 5.6–7.0 mm in males; FLL 7.4 mm in the female), relative lengths of fingers I<II<IV<III, tips of fingers round; fingers free of webbing; fingers without lateral fringes, subarticular tubercles absent; inner metatarsal tubercle present; outer metatarsal tubercle absent. Thigh relatively short and stocky (FeL 13.4–15.3 mm in males; FeL 18.3 mm in the female); tibia approximately seven times longer than wide (TbL 15.6–17.1 mm, TW 2.2–3.0 mm in males; TbL 21.7 mm, TbW 3.1 mm in the female); tips of toes round; relative lengths of toes I<II<V<III<IV; toes free of webbing; subarticular tubercles absent; inner metatarsal tubercle present; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the nostril when leg adpressed along body. Skin: dorsal surface of body, limbs, and lateral surface of head weakly granular; flanks with small, scattered tubercles; chest, belly, and ventral surfaces of limbs smooth.

Coloration in life: dorsal surface and lateral sides of head, body, forelimbs and hindlimbs grey; a brown Y-shaped marking on dorsum between the eyes; hind and forelimbs possess brown bars; tubercles on flanks encircled by brown; groin red-orange; ventral surface grey with white pattern; inner metatarsal tubercles on feet red-orange.

Distribution. In Vietnam, this species has been reported from Lao Cai Province (Tapley et al. 2017). Elsewhere, the species is known from Yunnan Province, China (Frost 2020).

Family Dicroglossidae Anderson, 1871

***Limnonectes bannaensis* Ye, Fei & Jiang, 2007**

Banna Large-headed Frog

Figure 3E

Material examined. VIETNAM – Lai Chau Province • Sin Ho District, Sao Sang-Ta Ngao Village; 22.266850°N,

103.263983°E; alt. 1139 m; 12.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water of streams, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 1 ♂, 4 ♀; IEBR 4778–4782 • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.356833°N, 103.605617°E; alt. 1429 m; 22.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water of streams, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 1 ♂; IEBR 4783 • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.355233°N, 103.608200°E; alt. 1370 m; 23.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water of streams, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 1 ♂, 1 ♀; IEBR 4784–4785.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those reported by Ye et al. (2007) and McLeod et al. (2015). SVL 40.8–50.3 mm in males, SVL 48.5–68.8 mm in females; head narrower than long (HW 15.9–18.0 mm, HL 17.3–20.3 mm in males; HW 19.3–25.8 mm, HL 20.0–25.5 mm in females); snout round, longer than eye diameter (RL 6.1–6.5 mm, ED 4.2–5.7 mm in males; RL 6.9–9.0 mm, ED 5.6–8.2 mm in females); nostril oval, laterally positioned, closer to the tip of snout than to eye (NS 2.7–3.0 mm, EN 3.0–3.7 mm in males; NS 2.9–4.0 mm, EN 4.0–5.6 mm in females); canthus rostralis indistinct, eye large (ED 4.2–5.7 mm in males; ED 5.6–8.2 mm in females), tympanum hidden; supratympanic fold distinct; vomerine teeth present; tongue notched posteriorly. Arm short (FLL 8.7–9.7 mm in males; FLL 9.7–12.8 mm in females), relative lengths of fingers I<II<IV<III, tips of fingers obtuse or slightly swollen; fingers free of webbing; subarticular tubercles distinct, formula 1, 1, 2, 2; inner metatarsal tubercle indistinct. Thigh short (FeL 18.8–24.5 mm in males; FeL 21.4–32.7 mm in females); tibia approximately three times longer than wide (TbL 19.1–24.0 mm, TW 7.3–8.6 mm in males; TbL 21.6–31.8 mm, TW 8.8–11.1 mm in females); tips of toes swollen; relative lengths of toes I<II<V<III<IV; webbing complete; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle large; outer metatarsal tubercle absent; tibio-tarsal articulation reaching posterior edge of eye when leg adpressed along body. Skin: dorsal surface of head and body smooth; flank with small tubercles; small and homogenous tubercles on the leg and foot, ventral surface smooth.

Coloration in life: dorsal surface yellow-brown, mostly with black mottling or marbling, sometimes with brownish vertebral stripe; lower region of flanks brownish; upper limbs with brown transversal bands; throat, pectoral region, belly, and outer edges of limbs with black mottles.

Distribution. In Vietnam, this species has been reported from Cao Bang, Ha Giang, and Dien Bien provinces in

the north southwards to Quang Binh Province (Frost 2020). Elsewhere, the species is known from Laos and Yunnan and Guangxi provinces, China (Frost 2020).

Nanorana aenea (Smith, 1922)

Doi Chang Asian Frog

Figure 3F

Material examined. VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.397517°N, 103.595983°E; alt. 1579 m; 17.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water of a large stream, surrounding habitat covered by secondary forest of medium-sized and large hardwoods and shrubs; 4 ♂, 2 ♀; IEBR 4786–4791.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those reported by Taylor (1962) and Pham et al. (2012). Size large (SVL 59.8–82.0 mm in males, SVL 57.4–65.8 mm in females); head as wide as long (HW 23.8–32.4 mm, HL 23.7–29.3 mm in males; HW 21.5–25.4 mm, HL 21.6–26.2 mm in females); snout round, longer than eye diameter (RL 9.2–13.1 mm, ED 7.1–8.6 mm in males; RL 8.7–9.7 mm, ED 7.3–8.0 mm in females); nostril oval, laterally positioned, closer to the eye than to tip of snout (NS 4.8–6.5 mm, EN 4.0–5.3 mm in males; NS 4.7–5.0 mm, EN 4.0–4.5 mm in females); canthus rostralis distinct, eye large (ED 7.1–8.6 mm in males; ED 7.3–8.0 mm in females), tympanum indistinct; supratympanic fold indistinct, vomerine teeth present; tongue notched posteriorly. Arm short (FLL 13.1–18.1 mm in males and FLL 11.4–14.1 mm in females), relative lengths of fingers IV<II<I<III in males and relative lengths of fingers II<I<IV<III in females, tips of fingers slightly swollen; fingers free of webbing; subarticular tubercles distinct, formula 1, 1, 2, 1; inner metatarsal tubercle present, oval. Thigh long (FeL 37.8–49.9 mm in males and FeL 32.5–40.3 mm in females); tibia approximately four times longer than wide in males (TbL 40.2–51.0 mm, TW 9.3–12.6 mm) and tibia approximately five times longer than wide in females (TbL 36.5–41.4 mm, TW 6.6–8.8 mm); tips of toes swollen; relative lengths of toes I<II<III<V<IV; webbing formula I½–III½–IIII½–2IV2–½V; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle present, round; outer metatarsal tubercle absent; tibio-tarsal articulation reaching well beyond snout when leg adpressed along body. Skin: dorsal surface quite smooth, posterior half of upper eyelid warty, a glandular fold from eye to shoulder, a fine glandular dorsolateral fold beginning behind upper eyelid, upper limbs smooth, underside of limbs and venter smooth.

Coloration in life: dorsal surface of head and body grey-brown; dorsolateral fold indicated by a thin black line; upper lip dark brown, lower region of flanks brownish with black spots; upper limbs brown with black bands; chest, belly and under limbs cream.

Distribution. In Vietnam, this species has been reported from Lao Cai, Son La, and Nghe An provinces (Nguyen et al. 2009; Pham et al. 2012). Elsewhere, the species is known from Yunnan Province of China and northwestern Thailand (Frost 2020).

***Nanorana yunnanensis* (Anderson, 1879)**

Yunnan Paa Frog

Figure 3G

Material examined. VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.564433°N, 103.598283°E; alt. 1679 m; 17.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water near a waterfall of a the rocky stream, surrounding habitat covered by secondary forest of medium-sized and large hardwoods; 1 ♂; IEBR 4792 • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.411667°N, 103.607750°E; alt. 2447 m; 18.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water near a waterfall of the a rocky stream, surrounding habitat covered by secondary forest of medium-sized and large hardwoods; 3 ♂, 1 ♀; IEBR 4793–4796.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Liu (1950) and Fei et al. (2010). Size large (SVL 83.7–110.6 mm in males, SVL 73.1 mm in the female); head wider than long (HW 32.0–42.7 mm, HL 31.0–39.5 mm in males; HW 30.0 mm, HL 28.6 mm in the female); snout round, longer than eye diameter (RL 11.0–14.2 mm, ED 7.8–9.3 mm in males; RL 10.1 mm, ED 6.9 mm in the female); nostril oval, laterally positioned, closer to the eye than to tip of snout (NS 6.8–8.8 mm, EN 4.0–5.8 mm in males; NS 6.5 mm, EN 3.9 mm in the female); canthus rostralis indistinct, eye large (ED 7.8–9.3 mm in males; ED 6.9 mm in the female), tympanum hidden; supratympanic fold distinct, vomerine teeth present; tongue notched posteriorly. Arm short (FLL 15.4–21.6 mm in males; FLL 12.7 mm in the female), relative lengths of fingers I<II<IV<III, tips of fingers obtuse; fingers free of webbing; subarticular tubercles distinct, formula 1, 1, 2, 2; two palmar tubercles, inner larger and more prominent. Thigh short (FeL 37.8–52.2 mm in males; FeL 36.1 mm in the female); tibia approximately three times longer than wide (TbL 42.2–55.0 mm, TW 14.7–19.7 mm in males; TbL 37.1 mm, TW 10.9 mm in the female); tips of toes round; relative lengths of toes I<II<V<III<IV; webbing formula I0–½II½–0III0–0IV0–0V; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the shoulder when leg adpressed along body. Skin: dorsal surface of head and body granular, with numerous small warts on the back, some elongate, these granules and warts bearing black horny spinules. Ventral surface smooth, horny spines forming two patches on the chest and throat, and more dense patches on the inner metacarpal tubercle and on the upper side of the first and second fingers.

Coloration in life: dorsal surface of head and body brown, with indistinct black spots; limbs with dark brown cross bars; upper hind limbs brown with black horny spinules; ventral surface cream with white spots. Adult males with black horny spines on chest, throat, inner metacarpal tubercle and on the upper side of the first and second fingers.

Distribution. In Vietnam, this species has been reported from Lao Cai, Son La, Cao Bang, and Nghe An provinces (Nguyen et al. 2009; Frost 2020). Elsewhere, the species is known from Myanmar and Yunnan and Guizhou provinces of China (Frost 2020).

***Quasipaa verrucospinosa* (Bourret, 1937)**

Spiny Frog

Figure 3H

Material examined. VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.381500°N, 103.604333°E; alt. 1465 m; 15.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water of a rocky stream, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 1 ♂, 2 ♀; IEBR 4797–4799.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those reported by Hu et al. (2005) and Fei et al. (2010). Size large (SVL 106.4 mm in the male, SVL 86.0–86.7 mm in females); head wider than long (HW 42.7 mm, HL 40.7 mm in the male; HW 34.7–35.0 mm, HL 32.7–33.4 mm in females); snout round, longer than eye diameter (RL 15.0 mm, ED 9.9 mm in the male; RL 12.6–12.8 mm, ED 8.5–9.5 mm in females); nostril oval, laterally positioned, closer to the eye than to the tip of snout (NS 8.3 mm, EN 6.3 mm in the male; NS 6.6 mm, EN 6.1 mm in females); canthus rostralis indistinct, eye large (ED 9.9 mm in the male; ED 8.5–9.5 mm in females); tympanum indistinct; supratympanic fold distinct; vomerine teeth present; tongue notched posteriorly. Arm short (FLL 18.3 mm in the male; FLL 14.7–15.8 mm in females), relative lengths of fingers I<II<IV<III in the male and relative lengths of fingers I<II<IV=III in females, tips of fingers slightly swollen; fingers free of webbing; subarticular tubercles distinct, formula 1, 1, 1, 1; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent. Thigh short (FeL 52.7 mm in the male, FeL 38.6–48.1 mm in females); tibia approximately three times longer than wide (TbL 59.1 mm, TW 20.5 mm in the male; TbL 46.8–47.0 mm, TW 12.8–15.0 mm in females); tips of toes swollen; relative lengths of toes I<II<V<III<IV; webbing complete; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle present, round; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the shoulder when leg adpressed along body. Skin: dorsal surface of head and body granular, back with large oval warts intermixed with small tubercles; upper surface of fore and hind limbs granular; small black spinule

present on fingers I and II during breeding season; venter smooth.

Coloration in life: dorsal surface of head dark brown; lips and upper limbs with black bars; deep-brown upper surface of limbs; throat with black marbling; belly cream with black pattern (Hu et al. 2005; Fei et al. 2010).

Distribution. In Vietnam, this species has been reported from northern to central Vietnam (Nguyen et al. 2009). Elsewhere, the species is known from Yunnan Province of China and Longcheng of Laos (Frost 2020).

Family Ranidae Batsch, 1796

Odorrana chloronota (Günther, 1876)

Chloronate Huia Frog

Figure 4A

Material examined. VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.355233°N, 103.608200°E; alt. 1370 m; 23.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the ground near a waterfall of a rocky stream, surrounding habitat covered by mixed secondary forest of bamboo, small to medium-sized hardwoods and shrubs; 8 ♂, 1 ♀; IEBR 4800–4808.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Bourret (1942) and Bain et al. (2003). Males smaller than female (SVL 44.2–45.6 mm in males, SVL 96.0 mm in the female); head narrower than long (HW 14.0–15.0 mm, HL 17.0–19.0 mm in males; HW 31.0 mm, HL 37.0 mm in the female); snout round, longer than eye diameter (RL 6.7–7.3 mm, ED 5.9–6.3 mm in males; RL 13.8 mm, ED 11.8 mm in the female); nostril oval, laterally positioned, closer to the tip of snout than to eye (NS 2.5–3.4 mm, EN 4.0–4.7 mm in males; NS 6.0 mm, EN 8.5 mm in the female); canthus rostralis distinct, eye large (ED 5.9–6.3 mm in males; ED 11.8 mm in the female), tympanum distinct (TYD 3.8–4.5 mm in males; TYD 5.0 mm in the female); supratympanic fold indistinct, vomerine teeth present; tongue deeply notched posteriorly; males with vocal sacs. Arm slender (FLL 8.6–11.1 mm in males and FLL 16.2 mm in the female), relative lengths of fingers I<II<IV<III, tips of fingers enlarged into discs; fingers free of webbing; subarticular tubercles distinct, formula 1, 1, 2, 2; inner metatarsal tubercle present, round; outer metatarsal tubercle absent. Thigh slender (FeL 23.4–26.2 mm in males, FeL 57.4 mm in the female); tibia approximately seven times longer than wide in males (TbL 27.8–30.6 mm, TW 3.3–4.7 mm) and tibia approximately six times longer than wide in the female (TbL 65.0 mm, TW 10.2 mm); tips of toes enlarged into discs; relative lengths of toes I<II<V<III<IV in males and I<II<III<V<IV in the female; webbing complete; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle present, elongate; outer metatarsal tubercle absent; tibio-tarsal articulation reaching beyond tip of snout when leg adpressed along body. Skin: dorsal surface of head and

body smooth; flank with small tubercles, dorsolateral fold absent; ventral surface smooth.

Coloration in life: dorsum green with or without black spots, lateral side of head and flanks brownish grey, lips white; hind limbs with distinct black bars; webbing dark grey; throat and chest cream or whitish; ventral surface whitish.

Distribution. In Vietnam, this species has been reported from Bac Kan, Lang Son, Vinh Phuc, Quang Ninh and Lam Dong provinces (Nguyen et al. 2009). Elsewhere, the species has been reported from northeastern India and Myanmar to southern China (Frost 2020).

Odorrana jingdongensis Fei, Ye & Li, 2001

Jingdong Frog

Figure 4B

Material examined. VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.380933°N, 103.600500°E; alt. 1381 m; 15.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water of a large stream, surrounding habitat covered by secondary forest of medium-sized and large hardwoods and shrubs; 2 ♂, 2 ♀; IEBR 4809–4812 • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.351150°N, 103.613000°E; alt. 1170 m; 23.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water of a large stream, surrounded by secondary forest of medium-sized and large hardwoods and shrubs; 1 ♂; IEBR 4813.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those reported by Fei et al. (2010) and Ziegler et al. (2014). Size large (SVL 64.1–74.3 mm in males and SVL 88.0–105.7 mm in females); head narrower than long (HW 21.2–23.7 mm, HL 24.8–27.6 mm in males and HW 32.4–34.6 mm, HL 34.2–37.9 mm in females) snout round, longer than eye diameter (RL 10.1–11.3 mm, ED 8.6–10.0 mm in males and RL 14.2–15.3 mm, ED 10.8–11.1 mm in females); nostril oval, laterally positioned, closer to the tip of snout than to eye (NS 4.3–5.6 mm, EN 5.9–6.0 mm in males and NS 6.1–6.5 mm, EN 7.3–8.1 mm in females); canthus rostralis distinct, eye large (ED 8.6–10.0 mm in males and ED 10.8–11.1 mm in females), tympanum distinct (TYD 3.9–4.3 mm in males and TYD 4.7–5.2 mm in females); supratympanic fold indistinct, vomerine teeth present; tongue deeply notched posteriorly. Arm slender (FLL 12.7–16.2 mm in males and FLL 17.2–17.5 mm in females), relative lengths of fingers I<II<IV<III, tips of fingers enlarged into discs; fingers free of webbing; subarticular tubercles distinct, formula 1, 1, 2, 2; two palmar tubercles, inner larger and more prominent; nuptial pad present on finger I in males. Thigh slender (FeL 36.5–38.5 mm in males and FeL 49.6–56.5 mm in females); tibia approximately six times longer than wide in males (TbL 43.2–48.4 mm, TW 6.9–9.3 mm) and tibia four times longer than wide in the female (TbL 57.6–61.1 mm,

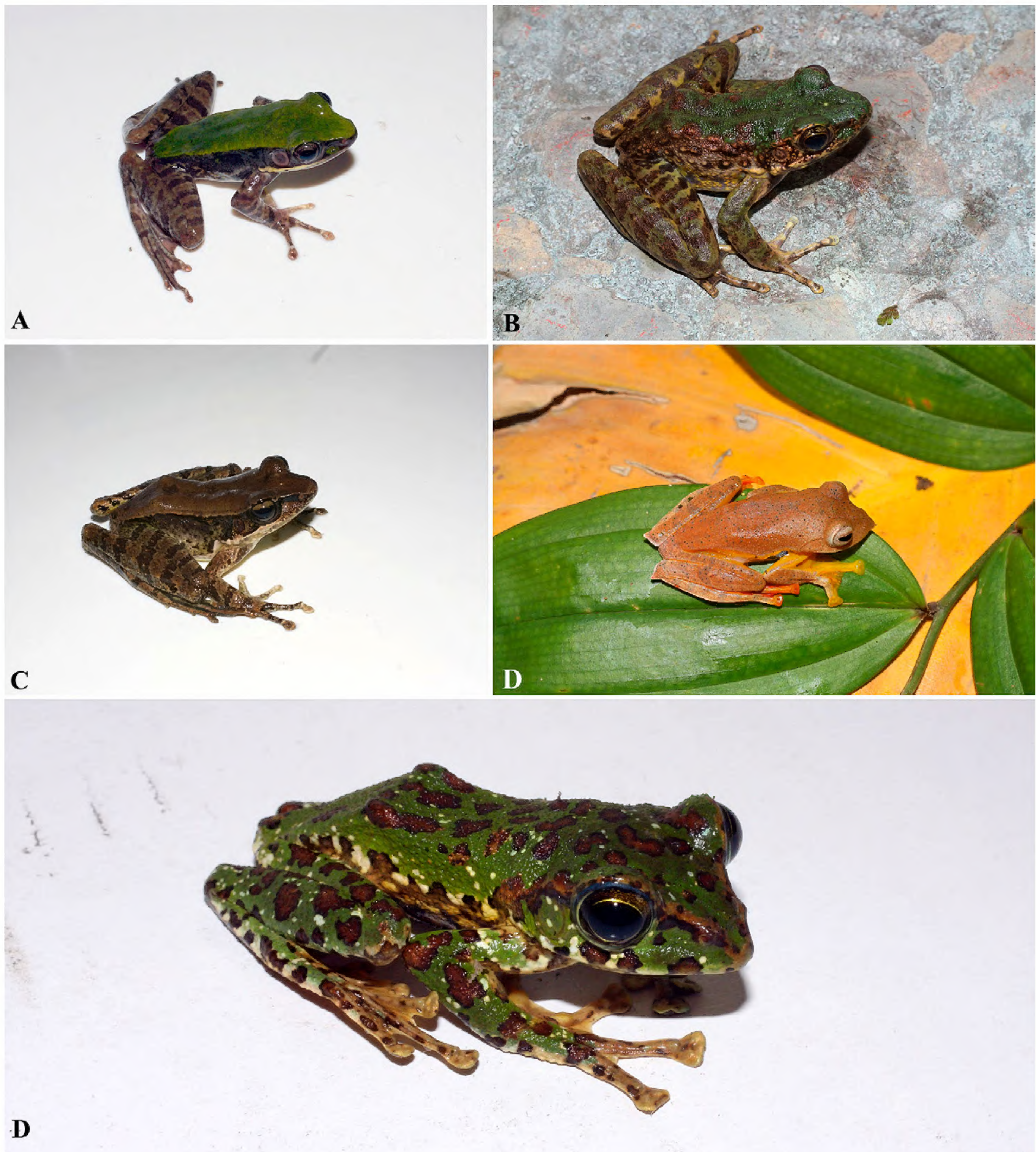


Figure 4. Amphibians from Lai Chau Province, Vietnam. **A–C.** Ranidae. **A.** *Odorrana chloronota* (IEBR 4800). **B.** *O. jingdongensis* (IEBR 4809). **C.** *O. nasica* (IEBR 4814). **D, E.** Rhacophoridae. **D.** *Rhacophorus rhodopus* (IEBR 4816). **E.** *Zhangixalus duboisi* (IEBR 4821). Photographs by Hoang CV.

TW 14.1–14.4 mm); tip of toes enlarged into discs; relative lengths of toes $I < II < III < V < IV$; webbing formula $I0-III0-III0-1\frac{1}{2}IV1\frac{1}{2}-0V$; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle elongate; outer metatarsal tubercle absent; tibio-tarsal articulation reaching beyond tip of snout when leg adpressed along body. Skin: dorsal surface of head and anterior of dorsum smooth, posterior of dorsum and flanks granular with tubercles; upper limbs and ventral surface smooth.

Coloration in life: dorsum green with large brown spots; dorsal surface of limbs brown with black cross

bars; flank brown with black spots; belly and throat cream, marbled with brown.

Distribution. In Vietnam, this species has been reported from Lao Cai, Ha Giang, and Dien Bien provinces (Nguyen et al. 2009; Frost 2020). Elsewhere, the species is known Yunnan and Guangxi provinces of China, northern Laos, and northeastern Myanmar (Frost 2020).

***Odorrana nasica* (Boulenger, 1903)**

Tonkin Huia Frog

Figure 4C

Material examined. VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.355233°N, 103.608200°E; alt. 1370 m; 23.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by mixed secondary forest of bamboo, small to medium-sized hardwoods and shrubs; 2♀; IEBR 4814–4815.

Identification. Morphological characteristics of the specimens from Lai Chau resembled those reported by Boulenger (1903) and Bain et al. (2003). Size large (SVL 69.1–78.4 mm); head narrower than long (HW 21.9–26.1 mm, HL 25.7–28.3 mm); snout round, longer than eye diameter (RL 10.0–10.9 mm, ED 6.4–8.4 mm); nostril oval, laterally positioned, closer to the tip of snout than to eye (NS 4.7–5.7 mm, EN 5.6–6.2 mm); canthus rostralis distinct, eye large (ED 6.4–8.4 mm), tympanum distinct (TYD 4.3–5.1 mm); supratympanic fold indistinct, vomerine teeth present; tongue notched posteriorly. Arm slender (FLL 14.5–14.9 mm), relative lengths of fingers II<I<IV<III, tips of fingers enlarged into discs; fingers free of webbing; subarticular tubercles distinct, formula 1, 1, 2, 2; inner metatarsal tubercle small; outer metatarsal tubercle absent. Thigh slender (FeL 41.3–41.8 mm); tibia approximately six times longer than wide (TbL 45.7–47.6 mm, TW 7.2–8.6 mm); tips of toes enlarged into discs; relative lengths of toes I<II<III<V<IV; webbing formula I0–½II½–0III0–0IV0–0V; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the tip of the snout when leg adpressed along body. Skin: dorsal surface of head and body smooth, a narrow glandular dorsolateral fold; upper limbs with small tubercles; ventral surface smooth.

Coloration in life: dorsal surface of head and body brown, with or without black spots; outer edge of glandular dorsolateral fold blackish; limbs with black cross bars; throat and chest cream with dark brown spots; belly olive.

Distribution. In Vietnam, this species has been reported from northern Vietnam: Lao Cai, Cao Bang to Thua Thien Hue provinces (Nguyen et al. 2009). Elsewhere, the species is known from Yunnan Province of China, Laos, and western and northwestern Thailand (Frost 2020).

Family Rhacophoridae Hoffman, 1932

Rhacophorus rhodopus Liu & Hu, 1960

Red-webbed Treefrog

Figure 4D

Material examined. VIETNAM – Lai Chau Province • Sin Ho District, Sa De Phin Commune, Sa De Phin Village; 22.312783°N, 103.220900°E; alt. 1918 m; 14.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the trees, about 1 m above the ground, near the stream, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 3 ♂, 2 ♀; IEBR 4816–4820.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Liu and Hu (1960) and Hecht et al. (2013). Medium-sized (SVL 31.8–39.7 mm in males, SVL 50.8–54.4 mm in females); head as wide as long (HW 11.8–14.1 mm, HL 12.0–13.7 mm in males; HW 17.3–18.3 mm, HL 18.5–19.0 mm in females); snout pointed, longer than eye diameter (RL 5.5–6.2 mm, ED 4.1–4.4 mm in males; RL 7.8–8.5 mm, ED 4.9–5.6 mm in females); nostril round, laterally positioned, closer to the tip of snout than to eye (NS 2.8–3.0 mm, EN 3.0–3.3 mm in males; NS 3.9 mm, EN 4.3–4.6 mm in females); canthus rostralis distinct, eye large (ED 4.1–4.4 mm in males; ED 4.9–5.6 mm in females), tympanum indistinct; supratympanic fold distinct, vomerine teeth present; tongue notched posteriorly. Arm slender (FLL 7.0–8.7 mm in males; FLL 11.1–12.2 mm in females), relative lengths of fingers I<II<IV<III, fingers enlarged into discs; webbing formula I1–III0–IIII1–0IV; subarticular tubercles distinct, formula 1, 1, 2, 1; inner metatarsal tubercle small; outer metatarsal tubercle absent. Thigh slender (FeL 14.6–17.4 mm in males; FeL 21.9–24.1 mm in females); tibia approximately seven times longer than wide (TbL 16.1–19.5 mm, TW 2.5–3.1 mm in males; TbL 24.2–25.3 mm, TW 3.4–3.9 mm in females); relative lengths of toes I<II<III<V<IV; toes fully webbed, formula I0–0II0–IIII0–IIV1–0V; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle small; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the eye when leg adpressed along body. Skin: dorsal surface of head and body smooth, fourth finger and fifth toe with dermal fringes, protuberances on outer edge of tarsus; ventral surface smooth.

Coloration in life: dorsum reddish brown with or without small black spots; large black blotches on axilla and flanks present; ventral surface yellowish; webbing of fingers and toes reddish orange.

Distribution. In Vietnam, this species has been reported from Lao Cai, Ha Tinh, Quang Binh, Quang Tri, Thua Thien Hue, Kon Tum, Gia Lai, Lam Dong, and Dong Nai provinces (Nguyen et al. 2009). Elsewhere, the species is known from northeastern India, Xizang, Yunnan, Guangxi and Hainan provinces of China, Myanmar, Laos, northern Thailand, and Cambodia (Frost 2020).

Zhangixalus duboisi (Ohler, Marquis, Swan & Grosjean, 2000)

Dubois' Whipping Frog

Figure 4E

Material examined. VIETNAM – Lai Chau Province • Sin Ho District, Sa De Phin Commune, Sa De Phin Village; 22.315767°N, 103.219167°E; alt. 1833 m; 14.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the tree branches near a small stream, about 0.5 m above the ground, surrounding habitat covered by mixed secondary forest of bamboo, small to medium-sized hardwoods and shrubs; 2 ♂; IEBR 4821–4822.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Ohler et al. (2000) and Ziegler et al. (2014). Medium-sized (SVL 54.0–59.0 mm); head as wide as long (HW 18.5–19.6 mm, HL 18.9–20.2 mm); snout obtuse, longer than eye diameter (RL 8.0–9.3 mm, ED 6.4–7.0 mm); nostril oval, laterally positioned, at the midway between eye and tip of snout (NS 4.0–4.5 mm, EN 4.5–5.3 mm); canthus rostralis distinct, eye large (ED 6.4–7.0 mm), tympanum distinct (TYD 4.8–4.9 mm); supratympanic fold distinct, vomerine teeth present; tongue notched posteriorly. Arm slender (FLL 11.3–13.5 mm), relative lengths of fingers I<II<IV<III, fingers enlarged into discs; webbing formula I1½–1½II1–2III1–1IV; subarticular tubercles distinct, formula 1, 2, 3, 2; two round palmar tubercles, inner larger and more prominent. Thigh slender (FeL 26.7–28.3 mm); tibia six times longer than wide (TbL 26.4–28.9 mm, TW 4.1–4.8 mm); relative lengths of toes I<II<III<V<IV; webbing formula IO–0II0–1III½–1IV1–1V; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the eye when leg adpressed along body. Skin: dorsal surface of head, body, and limbs granular; flank slightly granular; throat, chest, belly, and ventral aspect of thigh with small round flat granules.

Coloration in life: dorsal surface of head, body, and limbs green with large, dark, brown spots edged in black and some small white spots; flank and posterior surface of thigh white with dark brown marbling; belly grey-white with numerous small, medium-grey spots.

Distribution. In Vietnam, this species was previously reported from Lao Cai, Son La and Ha Giang provinces (Nguyen et al. 2009; Ziegler et al. 2014). Elsewhere, the species is known from Yunnan Province, China (Frost 2020).

Discussion

We record four species of Dicroglossidae (*Limnonectes bannaensis*, *Nanorana aenea*, *Nanorana yunnanensis*, and *Quasipaa verrucospinosa*), four species of Megophryidae (*Leptobrachium ailaonicum*, *Megophrys gigantea*, *M. jingdongensis*, and *M. rubrimera*), three species of Ranidae (*Odorrana chloronota*, *O. nasica*, and *O. jingdongensis*), and two species of Rhacophoridae (*Rhacophorus rhodopus* and *Zhangixalus duboisi*) for the first time from Lai Chau Province. Our new findings increase the species number of amphibians known to occur in this province from 32 to 45.

The amphibian fauna of Lai Chau Province is of high conservation concern as there are three known species to be endemic to Vietnam (*Megophrys hoanglienensis*, *Gracixalus sapaensis*, and *Tylototriton sparreboomi*), 10 species listed in the IUCN Red List (2020) (*Nanorana yunnanensis* [Endangered; EN], *Amolops minutus* [EN], *Theloderma bicolor* [EN], *Megophrys gigantea* [Vulnerable; VU], *Amolops splendissimus* [VU], *Gracixalus jinxiuensis*

[VU], *Leptobrachium ailaonicum* [Near Threatened; NT], *Quasipaa verrucospinosa* [NT], *Odorrana chapaensis* [VU], *O. grahami* [VU]), and two species listed in the Red Data Book of Vietnam (2007) (*Rhacophorus kio* [EN] and *Zhangixalus feae* [EN]). Considering the vulnerability of the amphibian diversity found in this province, protecting and restoration of the natural habitat and conducting additional studies in this province are essential.

Acknowledgements

We are grateful to the directorate of the Forest Protection Department of Lai Chau Province for supporting our field work. We thank A.V. Pham and N.B. Sung (Son La) for their assistance in the field. We thank T.A. Tran (Hanoi) for providing the map. For the productive collaboration within joint research projects, we cordially thank S.V. Nguyen (IEBR, Hanoi), as well as T. Pagel and C. Landsberg (Cologne Zoo). This research was funded by the Ministry of Science and Technology's Program 562 (grant no. ĐTDL.CN-64/19).

Authors' Contributions

MDL, TQN, and TZ designed the research; CTP, CHV, and TQP collected materials in the field; AML, CTP, QHD, and TQN wrote the manuscript; TQN, MDL, and TZ reviewed the manuscript.

References

- Bain RH, Lathrop A, Murphy RW, Orlov NL, Ho CT (2003) Cryptic species of a cascade frog from Southeast Asia: taxonomic revisions and descriptions of six new species. *American Museum Novitates* 3417: 1–60.
- Bernardes M, Le MD, Nguyen TQ, Pham CT, Pham AV, Nguyen TT, Rödder D, Bonkowski M, Ziegler T (2020) Integrative taxonomy reveals three new taxa within the *Tylototriton asperrimus* complex (Caudata, Salamandridae) from Vietnam. *ZooKeys* 935: 121–164. <https://doi.org/10.3897/zookeys.935.37138>
- Boulenger GA (1903) Descriptions of three new batrachians from Tonkin. *Annals and Magazine of Natural History (Series 7)* 12: 186–188. <https://doi.org/10.1080/00222930308678835>
- Bourret R (1942) Les batraciens de l'Indochine. Institut Océanographique de l'Indochine, Hanoi, Vietnam, 547 pp.
- Fei L, Hu S, Ye C, Huang Y (2009) *Fauna Sinica. Amphibia. Volume 3. Anura*. Science Press, Beijing, China, 887 pp.
- Fei L, Ye CY, Huang YZ (1983) Two new subspecies of *Megophrys omeimontis* Liu from China (Amphibia, Pelobatidae). *Acta Herpetologica Sinica/ Liangqi baxing dongwu yanjiu*. Chengdu (New Series) 2 (2): 49–52.
- Fei L, Ye C, Jaing J (2010) *Colored atlas of Chinese amphibians*. Sichuan Publishing House of Science and Technology, Sichuan, China, 519 pp.
- Frost DR (2020) *Amphibian species of the world: an online reference, version 6.0*. American Museum of Natural History, New York, USA. <http://research.amnh.org/herpetology/amphibia/index.html>. Accessed on: 2021-2-15.
- Glaw F, Vences M (2007) *A field guide to the amphibians and reptiles of Madagascar*. Third Edition. Frosch Verlag, Cologne, Germany, 496 pp.
- Hecht VL, Pham CT, Nguyen TT, Nguyen TQ, Bonkowski M, Ziegler T (2013) First report on the herpetofauna of Tay Yen Tu Nature Re-

serve, northeastern Vietnam. Biodiversity Journal 4 (4): 507–552.

Ho CT, Lathrop A, Murphy RW, Orlov N (1999) A redescription of *Vibrissaphora ailaonica* with a new record in Vietnam. Russian Journal of Herpetology 6 (1): 48–54.

Hu JS, Chen MY, Dong YH (2005) A new record of Amphibia (*Paa verrucospinosa*) again confirmation in China. Sichuan Journal of Zoology 24: 340–341.

IUCN (International Union for the Conservation of Nature) (2020) The IUCN Red List of Threatened Species. Version 2020.3. <https://www.iucnredlist.org/>. Accessed on: 2020-1-30.

Liu CC (1950) Amphibians of western China. Fieldiana, Zoology Memoirs 2: 1–397, 10 pls. <https://doi.org/10.5962/bhl.title.2977>

Liu CC, Hu SQ (1960) Preliminary report of Amphibia from southern Yunnan. Acta Zoologica Sinica 11: 508–538.

Liu CC, Hu SQ, Yang FH (1960) Amphibia of Yunnan collected in 1958. Acta Zoologica Sinica 12: 149–174.

Luong AM, Nguyen SLH, Pham CT, Nguyen TQ (2018) New provincial records of three species of *Megophrys* (Amphibia: Megophryidae) from Vietnam. In: Proceeding of the 3rd National Scientific Conference on Biological Research and Teaching in Vietnam, 284–290.

Luong AM, Pham AV, Nguyen TT, Nguyen TQ (2019) First record of *Megophrys gigantea* Liu, Hu et Yang, 1960 (Anura: Megophryidae) from Vietnam. Russian Journal of Herpetology 26: 201–204. <http://doi.org/10.30906/1026-2296-2019-26-4-201-204>

McLeod DS, Kurlbaum S, Hoang NV (2015) More of the same: a diminutive new species of the *Limnonectes kuhlii* complex from northern Vietnam (Anura: Dicroglossidae). Zootaxa 3947: 201–214. <http://doi.org/10.11646/zootaxa.3947.2.4>

Nguyen LP, Truong NH, Kieu TT, Le DT, Tran TT (2019) Distribution extension and tadpole description of *Leptobrachium ailaonicum* (Yang, Chen and Ma, 1983) (Anura: Megophryidae) in Vietnam. In: Proceedings of the 4th National Scientific Conference on Amphibians and Reptiles in Vietnam, 120–125.

Nguyen TV, Hoang CV, Tran TT, Nguyen TQ (2016) New record of *Xenophrys jingdongensis* (Fei & Ye, 1983) (Anura: Megophryidae) from Ha Giang Province, Vietnam. In: Proceeding of the 3rd National Scientific Conference on Amphibians and Reptiles in Vietnam, 111–115.

Nguyen VS, Ho TC, Nguyen QT (2009) Herpetofauna of Viet Nam. Edition Chimaira, Frankfurt, Germany, 768 pp.

Ohler A, Marquis O, Swan SR, Grosjean S (2000) Amphibian biodiversity of Hoang Lien Nature Reserve (Lao Cai Province, northern Vietnam) with description of two new species. Herpetozoa 13: 71–87.

Pham AV, Hoang NV, Nguyen TQ (2018) New records of *Nidirana chapaensis* (Bourret, 1937) and *Sylvirana menglaensis* (Fei, Ye, and Xie, 2008) (Amphibia: Anura: Ranidae) in Lai Chau Province, Vietnam. Journal of Science & Technology 180: 64–71.

Pham AV, Hoang TLQ, Pham CT, Nguyen TQ (2019) Diversity of the Family Rhacophoridae (Amphibia: Anura) in Lai Chau Province, Vietnam. VNU Journal of Science: Natural Sciences and Technology 35: 52–58. <https://doi.org/10.25073/2588-1140/vnunst.4880>

Pham AV, Nguyen TV, Nguyen SLH, Nguyen TQ (2012) First records of *Nanorana aenea* (Smith, 1922) and *Gracixalus quang* Rowley, Dau, Nguyen, Cao & Nguyen, 2011 (Amphibia: Anura) from Son La Province. In: Proceedings in the 2nd National Scientific Workshop Amphibia and Reptile in Vietnam, 38–43.

Simmons JE (2002) Herpetological collecting and collections management. Revised edition. Society for the Study of Amphibians and Reptiles. Herpetological Circular 31: 1–153.

Sung NB, Nguyen TQ, Pham CT, Hoang NV, Pham AV (2019) New records of *Leptobranchella minima* (Taylor, 1962) and *Sylvirana cubitalis* (Smith, 1917) from Lai Chau Province, Vietnam. In: Proceedings of the 4th National Scientific Conference on Amphibians and Reptiles in Vietnam, 192–197.

Tapley B, Cutajar TP, Mahony S, Nguyen CT, Dau VQ, Luong AM, Le DT, Nguyen TT, Nguyen TQ, Portway C, Luong HV, Rowley JLL (2018) Two new and potentially highly threatened *Megophrys* Horned frogs (Amphibia: Megophryidae) from Indochina’s highest mountains. Zootaxa 4508: 301–333. <https://doi.org/10.11646/zootaxa.4508.3.1>

Tapley B, Cutajar TP, Mahony S, Nguyen CT, Dau VQ, Nguyen TT, Luong HV, Rowley JLL (2017) The Vietnamese population of *Megophrys kuatunensis* (Amphibia: Megophryidae) represents a new species of Asian horned frog from Vietnam and southern China. Zootaxa 4344: 465–492. <https://doi.org/10.11646/zootaxa.4344.3.3>

Taylor EH (1962) The amphibian fauna of Thailand. University of Kansas Science Bulletin 43: 265–599.

The People’s Committee of Lai Chau Province (2019) Lai Chau Province Portal. <http://laichau.gov.vn>. Accessed on: 2020-04-30.

Ye CY, Fei L, Xie F, Jiang JP (2007) A new Ranidae species from China—*Limnonectes bannanensis* (Ranidae: Anura). Zoological Research 28: 545–550.

Ziegler T, Tran DTA, Nguyen TQ, Perl RGB, Wirk L, Kulisch M, Lehmann T, Rauhaus A, Nguyen TT, Le QK, Vu TN (2014) New amphibian and reptile records from Ha Giang Province, northern Vietnam. Herpetology Notes 7: 185–201.

Appendix

Table A1. List of species recorded from Lai Chau Province, Vietnam. An asterisk (*) denotes new provincial records. References include: 1 = Nguyen et al. (2009), 2 = Matsui et al. (2017), 3 = Pham et al. (2018), 4 = Tapley et al. (2018), 5 = Pham et al. (2019), 6 = Sung et al. (2019), 7 = Luong et al. (2019), 8 = Bernardes et al. (2020), 9 = this study.

| No. | Species name | Common name | Previous record |
|-----|--|-------------------------|-----------------|
| | AMPHIBIA Gray, 1825 | Amphibians | |
| | ANURA Fischer von Waldheim, 1813 | Frogs | |
| | Bombinatoridae Gray, 1825 | Firebelly toads | |
| 1 | <i>Bombina maxima</i> (Boulenger, 1905) | Yunnan Firebelly Toad | 1, 9 |
| | Bufonidae Gray, 1825 | Toads | |
| 2 | <i>Duttaphrynus melanostictus</i> (Schneider, 1799) | Doubtful Toad | 1, 9 |
| | Megophryidae Bonaparte, 1850 | Spadefoot frogs | |
| 3 | <i>Leptobrachium ailaonicum</i> (Yang, Chen & Ma, 1983)* | Ailao Spiny Toad | 9 |
| 4 | <i>Megophrys gigantea</i> Liu, Hu & Yang, 1960* | Giant Spadefoot Toad | 7 |
| 5 | <i>Megophrys hoanglienensis</i> Tapley, Cutajar, Mahony, Nguyen, Dau, Luong, Le, Nguyen, Nguyen, Portway, Luong & Rowley, 2018 | Hoang Lien Horned Frog | 4, 9 |
| 6 | <i>Megophrys jingdongensis</i> Fei & Ye, 1983* | Jingdong Horned Toad | 9 |
| 7 | <i>Megophrys rubrimera</i> Tapley, Cutajar, Mahony, Chung, Dau, Nguyen, Luong & Rowley, 2017* | Red-thighed Horned Frog | 9 |
| | Dicroglossidae Anderson, 1871 | True frogs | |
| 8 | <i>Fejervarya limnocharis</i> (Gravenhost, 1829) | Indian Cricket Frog | 1, 9 |

| No. | Species name | Common name | Previous record |
|-------------------------------------|---|------------------------------|-----------------|
| 9 | <i>Hoplobatrachus rugulosus</i> (Wiegmann, 1834) | Asian Peters Frog | 1 |
| 10 | <i>Limnonectes bannaensis</i> Ye, Fei & Jiang, 2007* | Banna Large-headed Frog | 9 |
| 11 | <i>Nanorana aenea</i> (Smith, 1922)* | Doi Chang Asian Frog | 9 |
| 12 | <i>Nanorana yunnanensis</i> (Anderson, 1879)* | Yunnan Paa Frog | 9 |
| 13 | <i>Quasipaa verrucospinosa</i> (Bourret, 1937)* | Verrucosa Spiny Frog | 9 |
| Ranidae Batsch, 1796 | | Ranids | |
| 14 | <i>Amolops minutus</i> Orlov & Ho, 2007 | Small sucker frog | 1, 9 |
| 15 | <i>Amolops splendissimus</i> Orlov & Ho, 2007 | Sky-night Torrent Frog | 9 |
| 16 | <i>Nidirana chapaensis</i> (Bourret, 1937) | Chapa Frog | 3, 9 |
| 17 | <i>Odorrana chapaensis</i> (Bourret, 1937) | Vietnam Sucker Frog | 1, 9 |
| 18 | <i>Odorrana chloronota</i> (Günther, 1876)* | Chloronate Huia Frog | 9 |
| 19 | <i>Odorrana grahami</i> (Boulenger, 1917) | Yunnanfu Frog | 1 |
| 20 | <i>Odorrana jingdongensis</i> Fei, Ye & Li, 2001* | Jingdong Frog | 9 |
| 21 | <i>Odorrana margaretae</i> (Liu, 1950) | Margareta’s Frog | 1 |
| 22 | <i>Odorrana nasica</i> (Boulenger, 1903)* | Tonkin Huia Frog | 9 |
| 23 | <i>Sylvirana cubitalis</i> (Smith, 1917) | Siam Frog | 6 |
| 24 | <i>Sylvirana guentheri</i> (Boulenger, 1882) | Gunther’s Amoy Frog | 1 |
| 25 | <i>Sylvirana menglaensis</i> (Fei, Ye & Xie, 2008) | Mengla Frog | 3 |
| Rhacophoridae Hoffman, 1932 | | Treefrogs | |
| 26 | <i>Kurixalus bisacculus</i> (Taylor, 1962) | Loei Flying Frog | 5, 9 |
| 27 | <i>Gracixalus carinensis</i> (Boulenger, 1893) | Burmese Bubble-nest Frog | 1 |
| 28 | <i>Gracixalus gracilipes</i> (Bourret, 1937) | Chapa Bubble-nest Frog | 1, 5, 9 |
| 29 | <i>Gracixalus jinxiuensis</i> (Hu, 1978) | Jinxiu Bubble-nest Frog | 1, 9 |
| 30 | <i>Gracixalus sapaensis</i> Matsui, Ohler, Eto & Nguyen, 2017 | Sa Pa Bubble-nest Frog | 2, 9 |
| 31 | <i>Polypedates megacephalus</i> Hallowell, 1861 | Hong Kong Whipping Frog | 5, 9 |
| 32 | <i>Raorchestes longchuanensis</i> (Yang & Li, 1978) | Longchuan Bubble-nest Frog | 1 |
| 33 | <i>Raorchestes parvulus</i> (Boulenger, 1893) | Karin Bubble-nest Frog | 1, 9 |
| 34 | <i>Rhacophorus kio</i> Ohler & Delorme, 2006 | Black-webbed Treefrog | 5 |
| 35 | <i>Rhacophorus rhodopus</i> Liu & Hu, 1960* | Red-webbed Treefrog | 9 |
| 36 | <i>Theloderma albopunctatum</i> (Liu & Hu, 1962) | Dotted Bubble-nest Frog | 1 |
| 38 | <i>Theloderma bicolor</i> (Bourret, 1937) | Chapa Bug-eyed Frog | 5, 9 |
| 39 | <i>Theloderma gordonii</i> Taylor, 1962 | Gordon’s Bug-eyed Frog | 1 |
| 40 | <i>Zhangixalus dorsoviridis</i> (Bourret, 1937) | Green-back Treefrog | 1, 5, 9 |
| 41 | <i>Zhangixalus duboisi</i> (Ohler, Marquis, Swan & Grosjean, 2000)* | Dubois’ Whipping Frog | 9 |
| 42 | <i>Zhangixalus feae</i> (Boulenger, 1893) | Thao Whipping Frog | 1, 5, 9 |
| 43 | <i>Zhangixalus puerensis</i> (He, 1999) | Sichuan whipping frog | 1, 5, 9 |
| CAUDATA | | Salamanders and newts | |
| Salamandridae Goldfuss, 1820 | | Salamanders | |
| 44 | <i>Tylototriton sparreboomi</i> Bernardes, Le, Nguyen, Pham, Pham, Nguyen & Ziegler, 2020 | Sparreboom’s Crocodile Newt | 8, 9 |
| 45 | <i>Tylototriton verrucosus</i> Anderson, 1871 | Himalayan Crocodile Newt | 1 |